

## ORIGINAL ARTICLE

# Underweight and overweight among children and adolescents in Tuscany (Italy). Prevalence and short-term trends

G. LAZZERI, S. ROSSI, A. PAMMOLLI\*, V. PILATO, T. POZZI, M.V. GIACCHI

CREPS, Research Centre for Health Promotion and Education, University of Siena; \*Department of Surgery, Biology Section, University of Siena, Italy

## Key words

Childhood • Adolescence • Thinness • Overweight • Obesity • BMI for age • Nutritional surveillance

## Summary

**Introduction.** The recent increase in both childhood obesity and adolescent anorexia nervosa in developed countries has underlined the important consequences that these trends may have on public health, as there is an increased risk that these conditions may become chronic diseases in adulthood. Therefore, it is necessary to monitor prevalence rates and trends in thinness and overweight (including obesity) among children and adolescents at different levels: international, national and sub-national.

Since 2001/2002, a nutritional surveillance system has been implemented in the Tuscany Region to estimate the nutritional status and lifestyles of children and adolescents.

The main objectives were to assess the prevalence of thinness, overweight and obesity among Tuscan children and adolescents and to provide baseline information on the prevalence of thinness, for the first time calculated according to the new international definitions, for geographical comparisons and descriptions of time trends.

**Methods.** Independent cross-sectional sample surveys were conducted in 2002, 2004 and 2006 in Tuscany, North-Central Italy. Data were collected from stratified two-stage cluster samples of children aged 9 years ( $n = 3,048$  in 2002 and  $n = 1,430$  in 2006) and of adolescents aged 11-13-15 years ( $n = 1,066$ ,  $n = 1,185$  and  $n = 1,160$  in 2004 and  $n = 1,189$ ,  $n = 1,211$  and  $n = 1,178$  in 2006, respectively). Weights and heights of primary school children were measured by means of standardized methods, while those of adolescents were self-reported. Decimal age was calculated from the date of birth to the date of measurement. Body Mass Index classes were calculated according to the International Obesity Task Force standards. Instead of the term underweight in children, we used the term thinness, which the World Health Organization uses to mean low Body Mass Index for age in adults and adolescents. According to Cole's recently published cut-offs for thinness, we divided our Body Mass Index values below 18.5 into three grades.

**Results.** This study presents data on the prevalence of different grades of nutritional status (thinness, normal weight, overweight and obesity) among Tuscan school-aged children from primary to high school (9-11-13-15-y-old), assessed by means of Body Mass Index, according to international definitions. From 2002

to 2006 the prevalence of thinness among children aged 9 years decreased from 4.6% to 4.2%, and the prevalence of normal weight from 63.7% to 62.4%; the prevalence of overweight (including obesity) rose from 31.7% to 33.4%. From 2004 to 2006, among pre-adolescents aged 11 years, the prevalence of thinness declined from 11.0% to 10.1%; the prevalence of normal weight rose from 68.4% to 70.2%, and the prevalence of overweight declined from 20.7% to 19.6%. Among adolescents aged 13 years, the prevalence of thinness declined from 9.8% to 8.0%; the prevalence of normal weight rose from 73.5% to 74.0%, and the prevalence of overweight from 16.8% to 17.9%. Among adolescents aged 15 years, the prevalence of thinness declined from 9.8% to 8.7%, and the prevalence of normal weight from 77.0% to 71.6%, while the prevalence of overweight rose from 13.3% to 19.7%. The 2006 data showed that the trend in the prevalence of overweight (including obesity) tended to decrease with age for both sexes, though more markedly in girls (from 34.0% at 9-y of age to 12.2% at 15-y of age) than in boys (from 32.8% at 9-y of age to 22.8% at 13-y of age to 27.5% at 15-y of age). By contrast, the prevalence of thinness increased with age in girls (from 4.9% at 9-y of age to 14.1% at 15-y of age), while boys presented a similar low prevalence at 9 and 15-y of age (3.3% and 3.1%), doubling the values at 11 and 13-y of age (7.5% and 6.5%). The trend in the prevalence of normal weight increased with age from 62.4% at 9-y of age to 74.0% at 13-y of age and to 71.6% at 15-y of age. Boys displayed a higher prevalence than girls only at 9-y of age (63.9% vs. 61.0%).

**Discussion.** The results of this study allow us to analyze data from the nutritional surveillance system in Tuscany using recent definitions of Body Mass Index cut-off points among children, pre-adolescents and adolescents. As a rule, the trend in the prevalence of overweight (including obesity) among girls from 9-y to 15-y-old strongly decreased, while the prevalence of thinness increased. In boys, this decrease was less marked and the prevalence of thinness displayed an irregular trend, with an increment from 9-y to 11-y-old and a decrease from 13-y to 15-y old. The trend in the prevalence of normal weight increased with age, with a higher prevalence among boys than girls.

## Introduction

The prevalence of obesity is increasing so rapidly in all age-groups in most European countries that the World Health Organization (WHO) has defined it as an epidemic and a

serious public health burden in Western countries [1]. The prevalence of childhood obesity is increasing worldwide and even developing countries are beginning to experience this trend. However, comparisons are difficult to make because of the different definitions used and the shortage

of studies at the national level [2]. Childhood obesity is one of several risk factors for cardiovascular and other chronic diseases, including hyperlipidaemia, hyperinsulinemia, hypertension and early atherosclerosis [3, 4]. Furthermore, reviews of studies on the long-term mortality related to overweight during childhood show a considerable increase in the risk of Chronic Heart Disease (CHD) mortality and overall mortality [5].

Underweight is also an emerging problem in some parts of the WHO European Region and among disadvantaged social groups. The main manifestation of under-nutrition in the European Region is stunting (low height for age), a sign of deprivation which increases the risk of morbidity, impairs cognitive development and reduces work productivity in later life [6].

Over the last 25 years, a notable increase in childhood obesity has been observed in economically developed countries (from 2.3 to 3.3 times in the United States and from 2.0 to 2.8 times in England) [2]. The incidence of childhood obesity in Western countries has more than doubled over the past generation [7]. The increasing incidence of childhood obesity is becoming a public health concern in developing countries, creating a socio-economic and public health burden for poorer areas [8]. In Egypt, for example, a 3.9-fold increase has been recorded in the last 18 years [2]. In Italy, regarding the prevalence of overweight and obesity in the pediatric age, the currently available data are difficult to compare and cannot be interpreted unequivocally, owing to the use of different definitions of childhood overweight and obesity.

Data on underweight in developed countries show an increasing trend of thinness with age in both sexes [9]. This study presents data on the prevalence of different grades of nutritional status (thinness, normal-weight, overweight and obesity) among Tuscan school-aged children from primary to high school (9-11-13-15y-old), assessed by using Body Mass Index (BMI), according to international definitions.

The aims of this study were to assess nutritional status with particular regard to the prevalence of thinness among children and adolescents in a representative regional sample by using BMI, according to the new international definitions, and the short-term changes that have occurred in the prevalence of thinness, normal-weight and overweight in subjects of this age.

## Methods

Similar data collection processes were used in all surveys: the main variables were weight, height, age, and sex. Nutritional status was estimated by means of BMI for age, according to Cole's cut-offs [10] for overweight and obesity, which cover the 2-18-year age-range and are based on the adult cut-offs of 25 and 30 at 18 years. We chose this reference because it has several advantages for international use. First, it is now a widely accepted BMI-based reference used for both childhood and adolescence overweight and obesity and is recommended for use in international comparisons. Second, this method provides

specific cut-off points for boys and girls, according to their exact age at measurement, expressed in decimal years. In addition, it has recently been extended to include low BMI for age in children and adolescents: Cole et al. defined three grades of thinness, linked to a BMI of 17 at age 18 (primary cut off), plus BMI 18.5 and 16 as secondary cut offs [11]. We used this new graded definitions: a) to complete the assessment of the nutritional status of Tuscan children and adolescents; b) to estimate the changes in nutritional status registered between the surveys of 2002 and 2006 (9-y-old) and those of 2004 and 2006 (11-13-15-y-old); c) to provide baseline information on the prevalence of thinness, for the first time calculated according to the new international definitions, for geographical comparisons and to describe time trends.

The data presented in this study were derived from two nutritional surveillance surveys conducted in Tuscany in 2002 and 2006 regarding 9-y-old schoolchildren. We have previously reported the project design and methods in detail [12, 13]. Specifically trained and standardized health personnel, using appropriate instruments, measured the height and weight of children in their schools, according to WHO recommendations [14]. Every child was weighed under standard conditions. Liquid crystal display electronic scales accurate to 100 grams were used. Height was measured with a fixed or portable stadiometer, with a precision of 0.1 cm; exact decimal age was calculated from the date of birth to the day of measurement; BMI was then calculated from weight and height, using the following formula: weight (kg)/height (m<sup>2</sup>).

Starting from 2004, surveillance was extended to school-aged pre-adolescents and adolescents (11-13-15-y-old). In this age-range, nutritional status, physical activity/sedentary lifestyle and nutritional habits were investigated by means of the same protocol and tools, while height and weight were self-reported in order to increase participation in the study [15].

## SAMPLING DESIGN

The same sampling procedures were used in all surveys. To guarantee the maximum territorial coverage, all 12 Local Health Districts (LHDs) in the Tuscany Region joined the nutritional surveillance project established in 2001. Following enrolment, LHD personnel met to discuss the protocol and to arrange the operational procedures to implement the project. The samples were then stratified to ensure reasonable geographical coverage.

Students were selected by a stratified two-stage sample with schools as Primary Sample Units (PSUs) and classes as clusters of students (sampling units) and primary stratification by corresponding LHD. Separately for each stratum, a with-replacement sample of schools was randomly chosen with probabilities that were proportional to the size (PPS) of the school (i.e. number of classes).

Surveys were conducted in 2002 (n = 3,048) and 2006 (n = 1,430) for 9-y age-group and in 2004 (n = 1,700 for each age) and 2006 (n = 1,500 for each age) for 11-13-15-y age-groups. The response rates were 86.0% and 83.0% in 2004 and 2006 for adolescents (mean value), and 91.3% in 2002 and 89.0% in 2006 for children.

Sample sizes were determined by assuming a confidence interval of  $\pm 3\%$  to detect prevalence rates of 50% ( $\alpha = 0.05$ , Design Effect = 1.5). In 2002 the sample size was larger, in order to maintain a good precision of estimates even in analysis at the local community level.

### STATISTICAL ANALYSIS

Descriptive statistics (e.g. mean, standard deviation of height, weight and BMI; prevalence of thinness, overweight and obesity in each year by age-group and sex) were used to establish the characteristics of the samples. To compute appropriate standard errors for estimates obtained from complex survey designs and to take account of the effects of stratification and clustering on the precision of survey estimates, standard errors of survey estimates and 95% confidence intervals were estimated on weighted data by the Taylor series linearization method. Average annual percentage increases in the prevalence of thinness, overweight and obesity in each age-group by sex during the periods covered by the surveys were calculated. Chi-square tests were conducted to test the differences in prevalence between surveys within each age-group. Statistically significant differences that resulted from multiple comparisons were evaluated by the Hochberg procedure [16].

Data analyses were performed by means of SPSS (version 15.0) and Complex Sample (EpiInfo version 3.3).

### Results

Table I reports the anthropometric characteristics of our sample, divided by sex.

Table II reports the nutritional status of children, pre-adolescents and adolescents in all surveys conducted. From

2002 to 2006 the prevalence of thinness among children aged 9 years was 4.6% vs. 4.2%; the prevalence of normal weight was 63.7% vs. 62.4%; the prevalence of overweight (including obesity) was 31.7% vs. 33.4%. From 2004 to 2006, among pre-adolescents aged 11 years, the prevalence of thinness was 11.0% vs. 10.1%; the prevalence of normal weight was 68.4% vs. 70.2%, and the prevalence of overweight was 20.7% vs. 19.6%. Among adolescents aged 13 years, the prevalence of thinness was 9.8% vs. 8.0%; the prevalence of normal weight was 73.5% vs. 74.0%, and the prevalence of overweight was 16.8% vs. 17.9%. Among adolescents aged 15 years, the prevalence of thinness was 9.8% vs. 8.7%; the prevalence of normal weight was 77.0% vs. 71.6%, and the prevalence of overweight was 13.3% vs. 19.7%. The 2006 data showed that the prevalence of overweight (including obesity) tended to decrease in both sexes as age increased; this trend was more marked in girls (from 34.0% at 9-y of age to 12.2% at 15-y of age) than in boys (from 32.8% at 9-y of age to 22.8% at 13-y of age to 27.5% at 15-y of age). By contrast, the prevalence of thinness increased with age in girls (from 4.9% at 9-y of age to 14.1% at 15-y of age), while boys displayed a similar low prevalence at 9 and 15 years of age (3.3% and 3.1%), doubling the values at 11 and 13-y of age (7.5% and 6.5%). The trend in the prevalence of normal weight increased with age from 62.4% at 9-y of age to 74.0% at 13-y of age to 71.6% at 15-y of age. Boys displayed a higher prevalence of normal weight than girls only at 9-y of age (63.9% vs. 61.0%).

Differences between different surveys, ages and sexes are shown in Figures 1, 3, 5, 7 for 9-y-old children, 11-y-old pre-adolescents and 13-15-y-old adolescents, respectively. Among 9-y-old children, there were no statistically significant differences in nutritional status between boys and girls in 2002 and 2006. Among pre-adolescents, the

Tab. I. Principle characteristics of the samples.

	Total Mean $\pm$ SD		Boys Mean $\pm$ SD		Girls Mean $\pm$ SD	
9 YEARS OLD	2002	2006	2002	2006	2002	2006
Age (years)	8.7 $\pm$ 0.4	8.8 $\pm$ 0.3	8.7 $\pm$ 0.4	8.8 $\pm$ 0.3	8.7 $\pm$ 0.4	8.8 $\pm$ 0.3
Weight (Kg)	32.1 $\pm$ 7.1	32.3 $\pm$ 6.8	32.6 $\pm$ 7.2	32.6 $\pm$ 6.9	31.5 $\pm$ 6.9	31.9 $\pm$ 6.6
Height (cm)	133.1 $\pm$ 6.1	133.2 $\pm$ 5.9	133.8 $\pm$ 6.1	133.7 $\pm$ 5.7	132.5 $\pm$ 6.1	132.7 $\pm$ 6.0
11 YEARS OLD	2004	2006	2004	2006	2004	2006
Age (years)	11.8 $\pm$ 0.6	11.6 $\pm$ 0.4	11.9 $\pm$ 0.6	11.6 $\pm$ 0.4	11.8 $\pm$ 0.5	11.6 $\pm$ 0.4
Weight (Kg)	44.1 $\pm$ 10.0	43.8 $\pm$ 10.5	44.9 $\pm$ 10.9	44.3 $\pm$ 10.3	43.3 $\pm$ 8.9	43.3 $\pm$ 10.8
Height (cm)	152.6 $\pm$ 9.3	152.5 $\pm$ 8.5	152.4 $\pm$ 9.5	152.3 $\pm$ 8.7	152.8 $\pm$ 9.5	152.6 $\pm$ 8.4
13 YEARS OLD	2004	2006	2004	2006	2004	2006
Age (years)	13.8 $\pm$ 0.6	13.6 $\pm$ 0.5	13.9 $\pm$ 0.6	13.7 $\pm$ 0.5	13.8 $\pm$ 0.6	13.6 $\pm$ 0.4
Weight (Kg)	54.6 $\pm$ 11.0	55.0 $\pm$ 13.8	56.8 $\pm$ 11.8	57.3 $\pm$ 14.5	51.9 $\pm$ 9.3	52.6 $\pm$ 12.5
Height (cm)	164.5 $\pm$ 8.4	164.5 $\pm$ 9.2	166.7 $\pm$ 9.0	166.6 $\pm$ 10.5	162.3 $\pm$ 7.1	162.3 $\pm$ 7.0
15 YEARS OLD	2004	2006	2004	2006	2004	2006
Age (years)	16.0 $\pm$ 0.8	15.7 $\pm$ 0.6	16.0 $\pm$ 0.8	15.8 $\pm$ 0.6	16.0 $\pm$ 0.8	15.7 $\pm$ 0.5
Weight (Kg)	60.9 $\pm$ 10.9	61.9 $\pm$ 13.2	66.2 $\pm$ 10.4	68.3 $\pm$ 12.6	55.6 $\pm$ 8.5	55.9 $\pm$ 10.8
Height (cm)	170.4 $\pm$ 8.8	170.1 $\pm$ 9.1	176.0 $\pm$ 7.1	175.8 $\pm$ 8.3	165.0 $\pm$ 6.6	164.7 $\pm$ 5.9

**Tab. II.** Nutritional status of 9- 11- 13- and 15-year-old children and adolescents in Tuscany.

	n	%	95% CI	n	%	95% CI
<b>9 years old</b>		<b>2002</b>			<b>2006</b>	
Thinness grade 3	4	0.1	0.03-0.5	4	0.3	0.1-0.8
Thinness grade 2	17	0.6	0.3-1.0	7	0.5	0.2-1.1
Thinness grade 1	120	3.9	3.2-4.9	48	3.4	2.5-4.7
Normal weight	1,941	63.7	61.5-65.8	893	62.4	59.9-64.0
Pre-obesity	695	22.8	21.0-24.7	359	25.1	22.9-27.5
Obesity	271	8.9	7.7-10.2	119	8.3	7.0-9.9
Total	3,048	100.0		1,430	100.0	
<b>11 years old</b>		<b>2004</b>			<b>2006</b>	
Thinness grade 3	11	1.0	0.6-1.4	11	1.1	0.5-1.7
Thinness grade 2	20	1.9	1.6-2.2	21	2.1	1.0-3.2
Thinness grade 1	86	8.1	7.0-9.1	69	6.9	5.6-8.4
Normal weight	729	68.4	65.8-71.0	700	70.2	67.4-73.0
Pre-obesity	184	17.3	15.9-18.6	164	16.4	13.9-19.0
Obesity	36	3.4	2.6-4.1	32	3.2	2.1-4.3
Total	1,066	100.0		997	100.0	
<b>13 years old</b>		<b>2004</b>			<b>2006</b>	
Thinness grade 3	9	0.8	0.5-1.0	10	0.9	0.4-1.5
Thinness grade 2	15	1.3	0.9-1.7	13	1.2	0.6-1.8
Thinness grade 1	91	7.7	6.8-8.6	64	5.9	4.3-7.5
Normal weight	871	73.5	72.3-74.7	804	74.0	70.9-77.2
Pre-obesity	160	13.5	12.5-14.5	160	14.7	12.4-17.0
Obesity	39	3.3	2.8-3.8	35	3.2	2.2-4.2
Total	1,185	100.0		1,086	100.0	
<b>15 years old</b>		<b>2004</b>			<b>2006</b>	
Thinness grade 3	10	0.9	0.4-1.4	9	0.8	0.2-1.4
Thinness grade 2	15	1.3	0.5-2.1	14	1.3	0.7-1.9
Thinness grade 1	88	7.6	5.9-9.3	71	6.6	5.9-8.1
Normal weight	893	77.0	74.7-79.3	772	71.6	68.5-74.7
Pre-obesity	139	12.0	10.0-13.9	184	17.1	14.6-19.5
Obesity	15	1.3	0.7-1.9	28	2.6	1.7-3.6
Total	1,160	100.0		1,078	100.0	

prevalence of both overweight and obesity was higher in boys than in girls in 2004 and 2006. A similar picture emerged among 13-y-old adolescents. The greatest differences between the prevalence of overweight and obesity of boys and girls were seen at age 15 in 2006. Statistically significant differences between boys and girls were found for obesity at age 11-y in 2004 and for overweight at ages 13-y and 15-y in 2004 and 2006. An increasing prevalence of overweight (statistically significant) and obesity was found from 2004 to 2006 in 15-y-old boys (15.5% and 2.1% vs. 23.7% and 3.8%), and girls (8.5% and 0.5% vs. 10.8% and 1.4%; no statistically significant increase). With regard to the degrees of thinness (Figs. 2, 4, 6, 8) the highest prevalence of grade-1 thinness was seen in 15-y-old girls in 2004 (11.2%) and 2006 (11.0%), while boys of same age displayed a value of 4.0% in 2004, with the lowest percentage (1.9%) in 2006.

The short-term trends between 2002 and 2006 for children, and 2004 and 2006 for pre-adolescents and adolescents (Tab. II), displayed the following pattern:

- the prevalence of thinness (combined proportions of thinness grades 1, 2 and 3) showed a decline in all age-groups;
- the prevalence of the normal weight increased over time from 68.4% to 70.2% only among 11-y-old pre-adolescents, and from 73.5% to 74.0% among 13-y-old adolescents, while it decreased from 63.7% to 62.4% among 9-y-old children, and from 77.0% to 71.6% among 15-y-old adolescents;
- the prevalence of overweight decreased from 20.7% to 19.6% only among 11-y-old pre-adolescents, while it increased from 31.7% to 33.4% among 9-y-old children, from 16.8% to 17.9% among 13-y-olds and from 13.3% to 19.7% among 15-y-olds. Generally,

Fig. 1. Nutritional status of 9-year-old children in Tuscany (2002 vs. 2006).

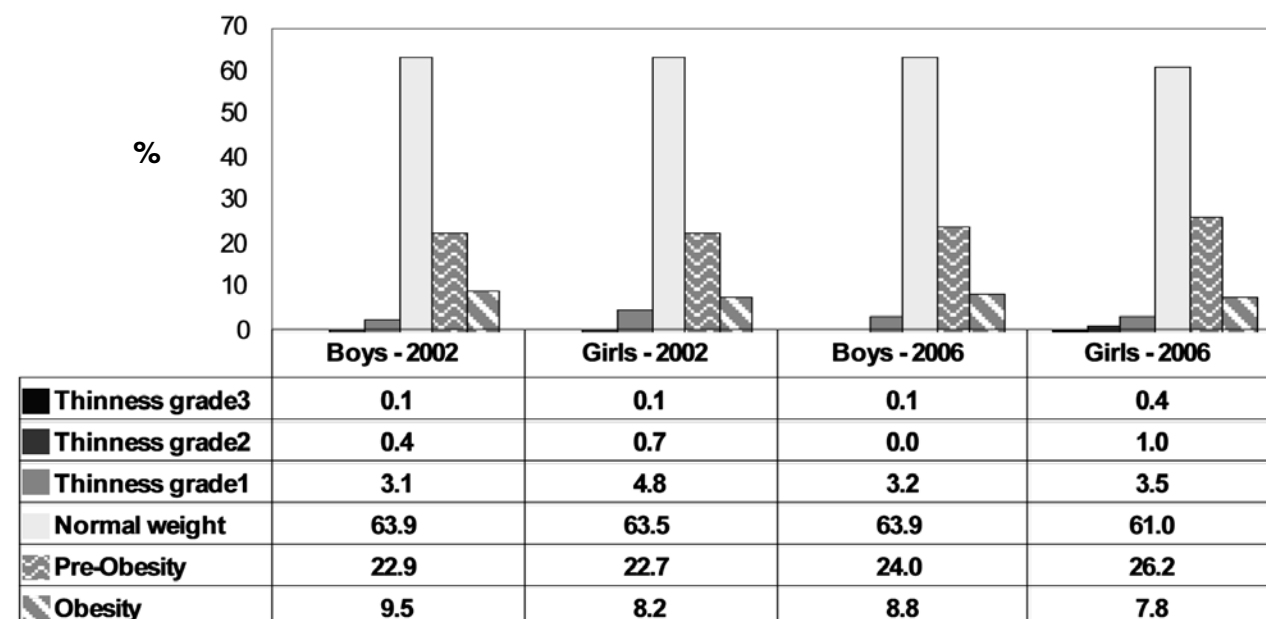
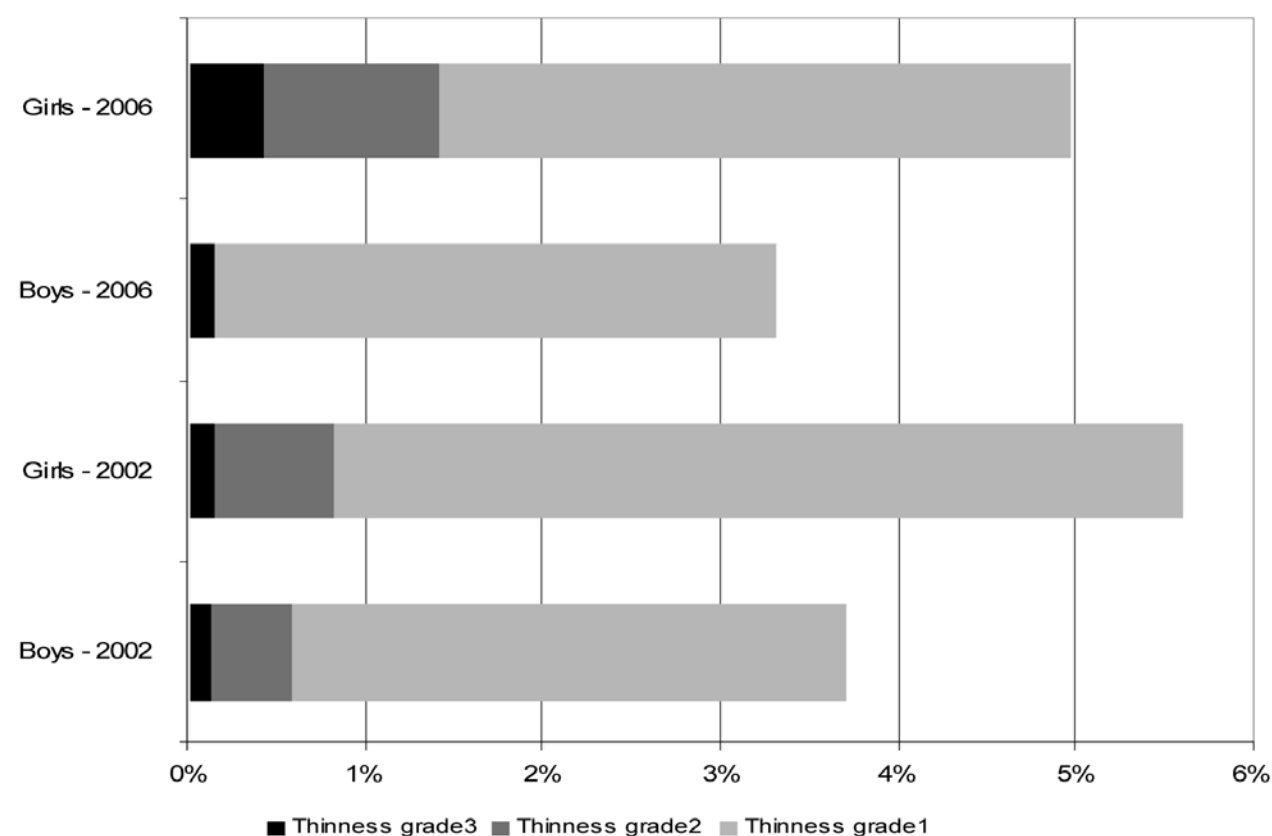


Fig. 2. Thinness grades of 9-year-old children in Tuscany (2002 vs. 2006).



this prevalence was considerably higher in children (over 30%) than in adolescents (20% or lower). To further examine the magnitude of change in the periods between surveys, the average annual change in the percentages of thinness and overweight (including obesity) were calculated (Tab. III). The prevalence of thinness showed

a declining trend in adolescents, with an average annual reduction of 0.45 to 0.9 percentage points in the 11, 13 and 15 age-groups (0.5 to 0.95 for boys and 0.1 to 1.15 for girls); a smaller reduction (0.1 percentage points) was seen in 9-y-old children. The average annual increase in the prevalence of overweight (including obesity) was

**Tab. III.** Average annual change (Mean  $\pm$  SEM) in the prevalence of overall overweight and thinness by age-group and sex.

	9 years		11 years		13 years		15 years	
	Thinness° %	Overall overweight* %	Thinness° %	Overall overweight* %	Thinness° %	Overall overweight* %	Thinness° %	Overall overweight* %
All	-0.10 $\pm$ 0.16	0.43 $\pm$ 0.38	-0.45 $\pm$ 0.68	-0.55 $\pm$ 0.88	-0.90 $\pm$ 0.60	0.55 $\pm$ 0.80	-0.55 $\pm$ 0.61	3.20 $\pm$ 0.78 <sup>§</sup>
Boys	-0.10 $\pm$ 0.20	0.10 $\pm$ 0.53	-0.95 $\pm$ 0.43	-0.75 $\pm$ 0.66	-0.50 $\pm$ 0.37	0.40 $\pm$ 0.61	-0.95 $\pm$ 0.29	4.95 $\pm$ 0.63 <sup>§</sup>
Girls	-0.16 $\pm$ 0.25	0.78 $\pm$ 0.54	-0.10 $\pm$ 0.52	0.05 $\pm$ 0.58	-1.15 $\pm$ 0.46	0.65 $\pm$ 0.49	-0.20 $\pm$ 0.52	1.60 $\pm$ 0.46

\* = Combined prevalence of pre-obesity and obesity (based on adult cut-off BMI > 25 at age 18); ° = Combined prevalence of thinness grades 1, 2 and 3 (based on adult cut-off BMI < 18.5 at age 18); § = Statistically significant difference within age-class,  $p < 0.001$  (Chi-square test)

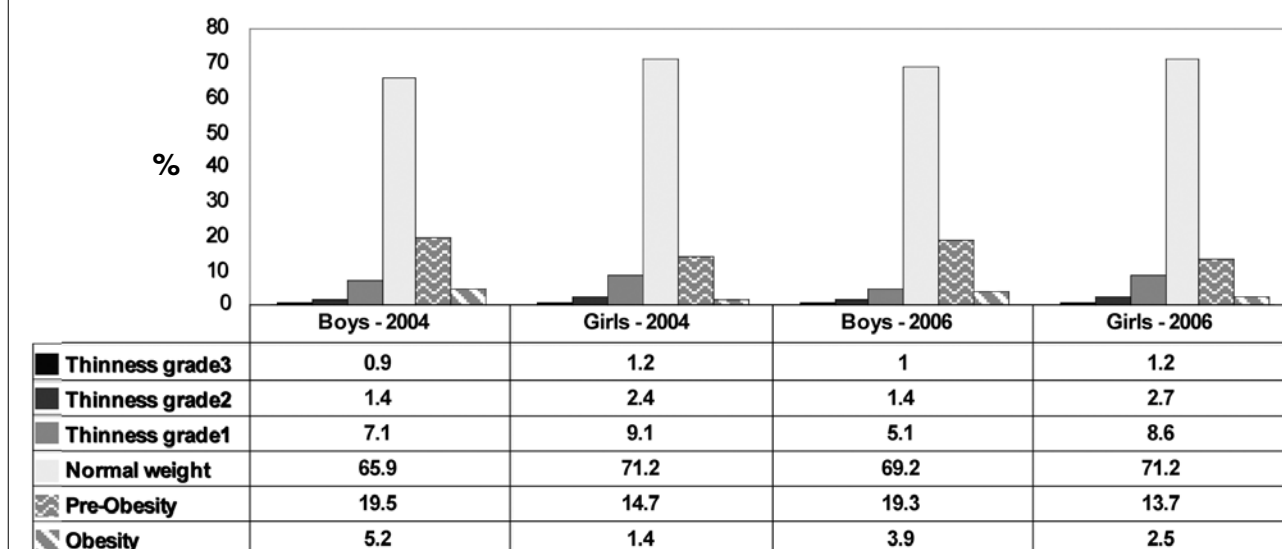
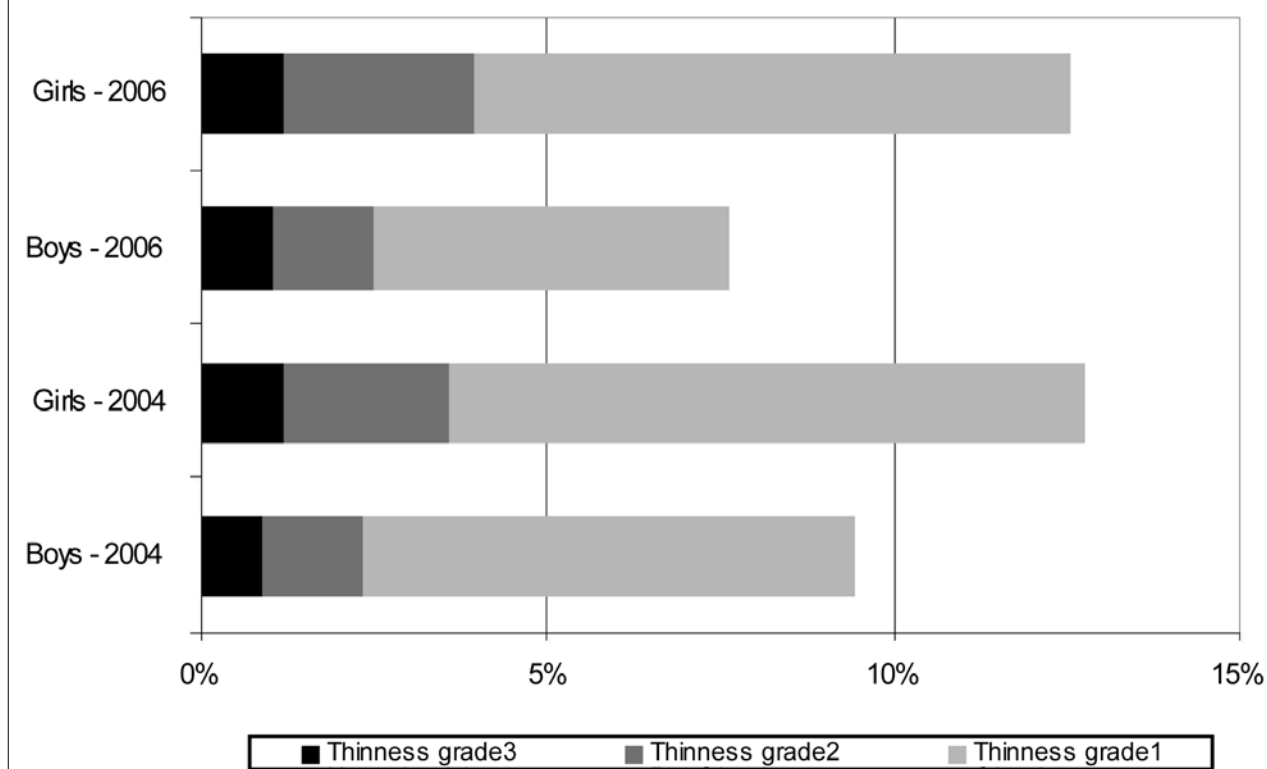
**Fig. 3.** Nutritional status of 11-year-old pre-adolescents in Tuscany (2004 vs. 2006).**Fig. 4.** Thinness grades of 11-year-old pre-adolescents in Tuscany (2004 vs. 2006).

Fig. 5. Nutritional status of 13-year-old adolescents in Tuscany (2004 vs. 2006).

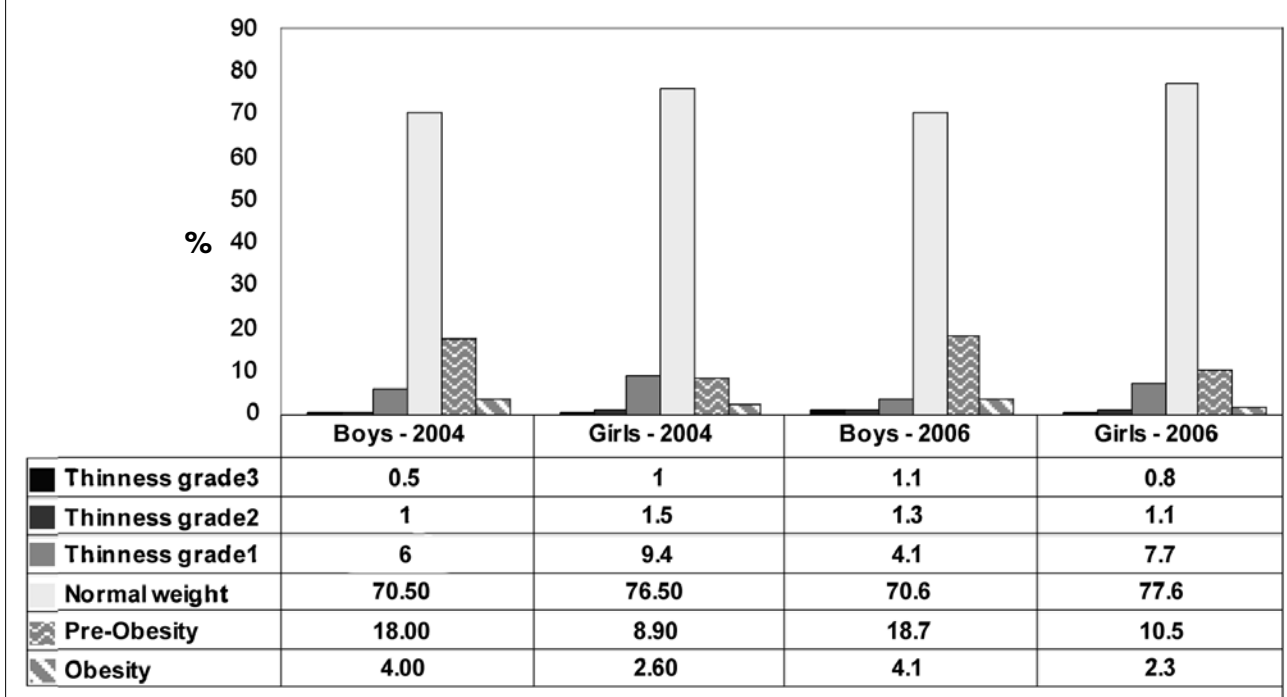
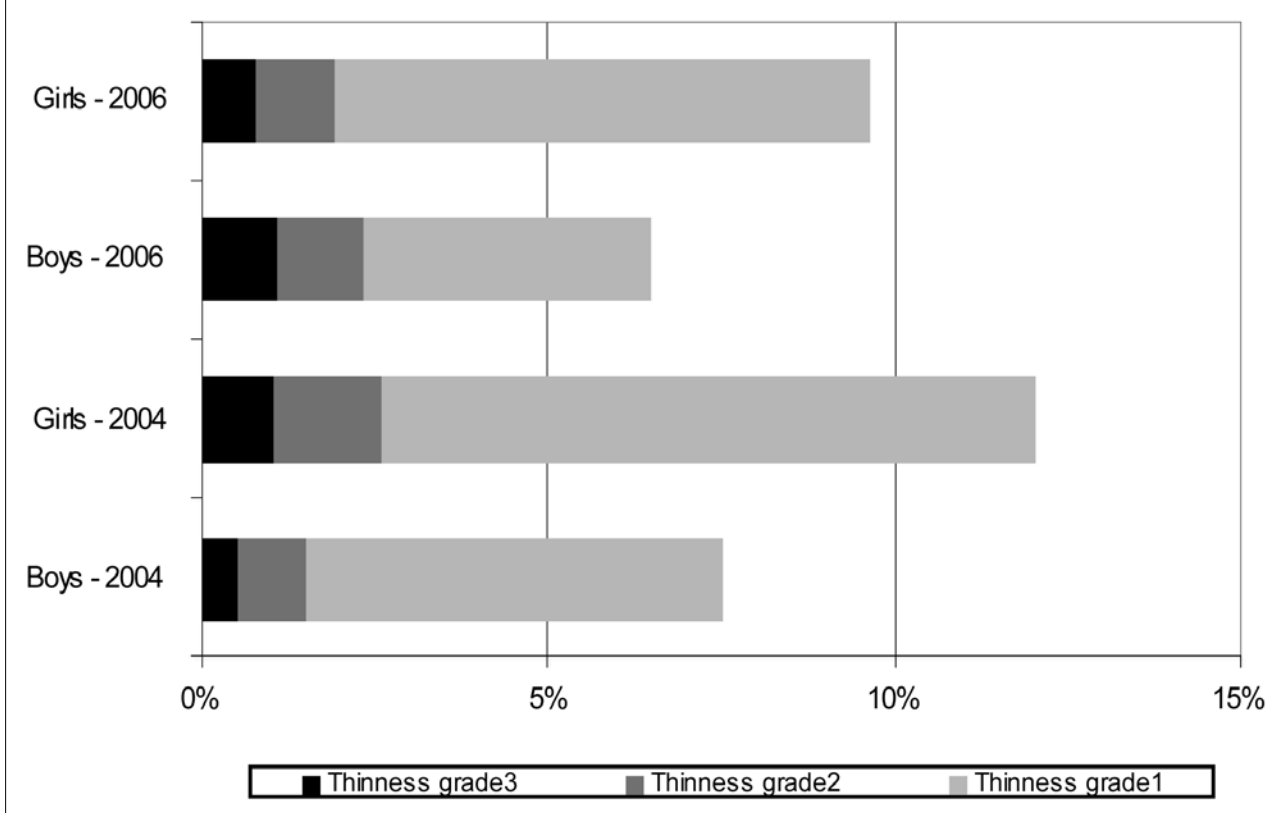


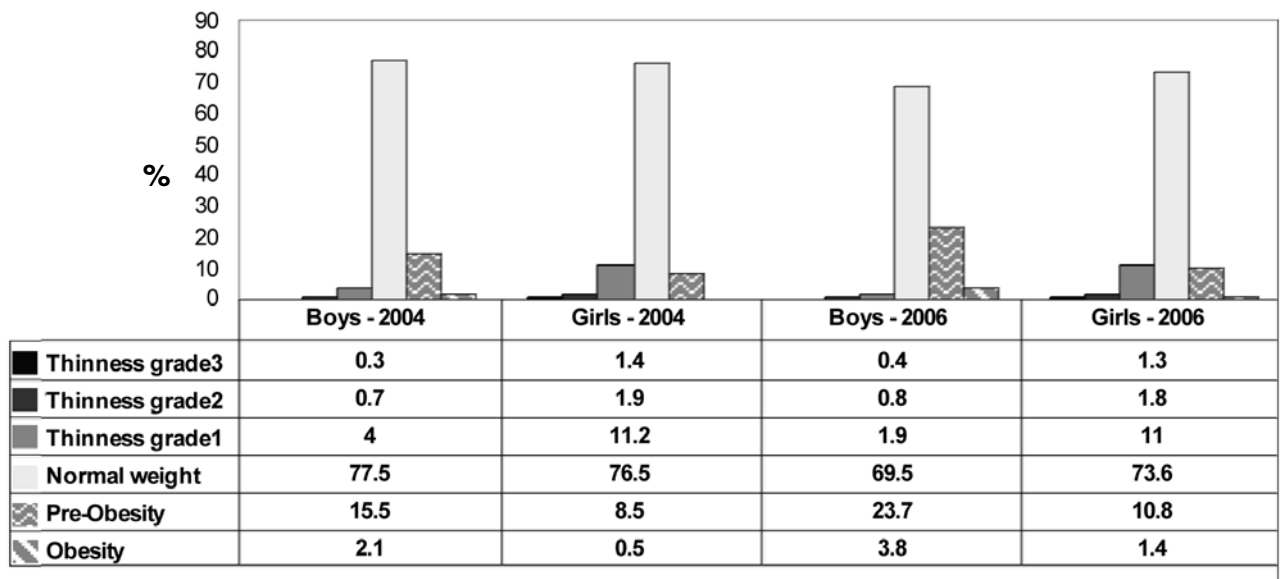
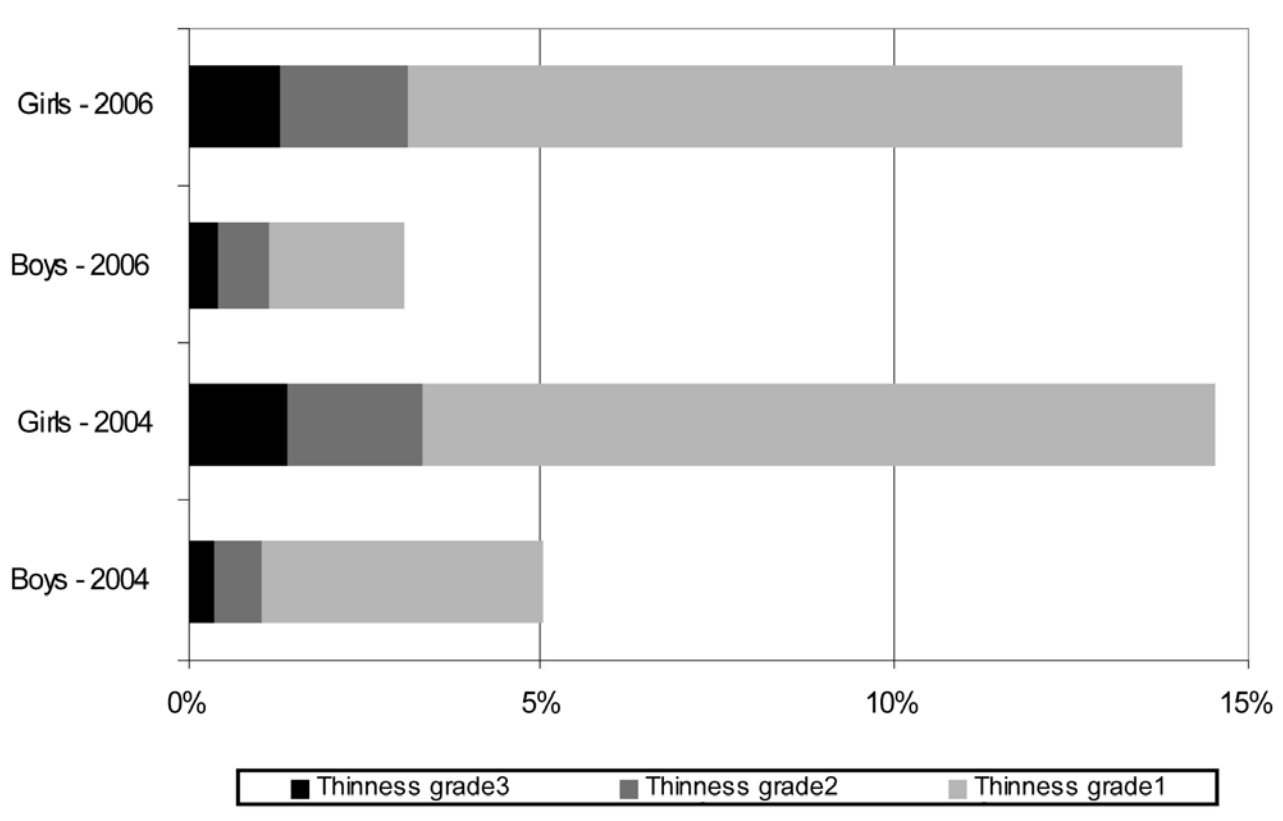
Fig. 6. Thinness grades of 13-year-old adolescents in Tuscany (2004 vs. 2006).



highest in the 15-y age-group (3.2 percentage points, statistically significant), followed by adolescents aged 13 (0.55 percentage points) and children aged 9 (0.43 percentage points). By contrast, this prevalence decreased in the 11-y age-group (0.55 percentage points).

## Discussion

In accordance with Cole's exhortation to "encourage direct comparison of trends in child and adolescent thinness worldwide", we reviewed our data from the surveillance

**Fig. 7.** Nutritional status of 15 year-old adolescents in Tuscany (2004 vs. 2006).**Fig. 8.** Thinness grades of 15 year-old adolescents in Tuscany (2004 vs. 2006).

system by applying the new definitions of thinness cut-offs in childhood and adolescents [11]. In this regard, we tested these cut-offs in a large regional data-set. Our aim was to provide baseline information on the prevalence of thinness that could be used in geographical comparisons, thereby contributing to identify a unified method for the evaluation of nutritional status in children and adolescents based on BMI cut-offs in adults.

The prevalence rates of overweight and obesity from our samples were compared with those of others studies which

we had previously published in detail [12, 15]. Data on the prevalence of thinness in children and adolescents according to the new definitions are scarce. Nevertheless, interesting data on the prevalence of thinness emerged from a French sample of 7-9-y-old children (39%), using different cut-offs (Must et al.) (CDC).

For 9-y-old children, we found prevalence rates of thinness of 3.3% in boys and 4.9% in girls in 2006, while Rolland-Cachera reports different values calculated by means of different cut-offs: 5.9% and 5.6% (French per-



centiles), 7.9% and 11.3% and 7.9% and 7.7%. We agree with Rolland-Cachera that the increasing prevalence of thinness with age, especially among girls, could be due to a greater attention to body weight [9].

Although Cole emphasizes that "these cut-offs are offered as a way forward and not as a definitive statement" [11], we can draw some tentative conclusions, especially with regard to the prevalence of thinness and normal weight. The prevalence of thinness clearly increased with age among girls, the highest value (14.1%) being recorded at 15-y of age. The prevalence of normal weight increased with age in both sexes. The prevalence of overweight (including obesity) declined from 9-y of age (34.0%) to 15-y of age (12.2%) in both sexes, but more clearly among girls than boys. The prevalence of overweight between the years of the surveys decreased only among 11-y-old pre-adolescents (from 20.7% to 19.6%), while it increased from 31.7% to 33.4% among 9-y-old children, from 16.8% to 17.9% among 13-y-old adolescents, and from 13.3% to 19.7% among 15-y-olds. Although caution must be exercised because of the short interval between the surveys, the increase in the prevalence of overweight proved to be similar to that reported in literature [17]. In conclusion the worldwide implementation of a nutritional surveillance system, with a unified method of defining nutritional status in children and adolescents based

on BMI cut-offs in adults, would enable us to assess the complete spectrum of weight status, from severe thinness to severe obesity. We now have the opportunity to better define cut-offs for different degrees of nutritional status in order to estimate trends in thinness, both in developed and developing countries, and to design the most effective prevention actions. The lessons learnt from the failures in fighting obesity must guide future public health strategies, based on the assessment and monitoring of nutritional status over time.

The aim must not only be to reduce the prevalence of thinness and/or overweight but also to promote positive action to increase the prevalence of normal weight.

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■ Correspondence: Prof. Mariano Giacchi, Department of Pathophysiology, Experimental Medicine and Public Health, Research Centre for Health, Promotion and Education, via A. Moro, 53100 Siena, Italy - Tel. +39 0577 234092 - Fax +39 0577 234090 - E-mail: [giacchi@unisi.it](mailto:giacchi@unisi.it).